EUROPEAN ACADEMIC RESEARCH
Vol. III, Issue 5/ August 2015

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

# Combined Level of Poultry Manure and NPKS Fertilizers on Growth and Yield of *Boro* Rice cv. BRRI dhan28 and BRRI dhan29

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**Abstract:**

*A field experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to evaluate the effect of combined level of poultry manure and NPKS fertilizers on the performance of Boro rice. Experimental treatments included two varieties of Boro rice viz. BRRI dhan28 and BRRI dhan29 and eight combined level of poultry manure and NPKS fertilizers viz. $M_1$= Control (No poultry manure and NPKS fertilizers), $M_2$=100% NPKS (Recommended dose of Urea = 305 kg $ha^{-1}$, TSP = 76 kg $ha^{-1}$, MP =60 kg $ha^{-1}$, Gypsum = 30 kg $ha^{-1}$), $M_3$= Poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS, $M_4$= Poultry manure at 5 t $ha^{-1}$ + 50% NPKS, $M_5$= Poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS, $M_6$= Poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS, $M_7$= Poultry manure at 5 t $ha^{-1}$ + 75% NPKS, and $M_8$= Poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS. The experiment was laid out in a randomized complete block design with three*

*replications. BRRI dhan28 produced higher total tillers hill$^{-1}$ (13.69), effective tillers hill$^{-1}$(10.62), non-effective tillers hill$^{-1}$(3.78), grains panicle$^{-1}$ (590.49) and harvest index (45.79%) and BRRI dhan29 showed higher response to all the remaining parameters such as plant height at harvest (81.38 cm), length of panicle (19.44 cm), sterile spikelets panicle$^{-1}$(137.85), total spikelets panicle$^{-1}$ (693.86), 1000-grain weight (24.74g), grain yield (4.33 t ha$^{-1}$), straw yield (5.32 t ha$^{-1}$) and sterility percentage (19%). The highest number of total tillers hill$^{-1}$ (14.90), number of non-effective tillers hill$^{-1}$ (4.328), panicle length (20.35), number of grains panicle$^{-1}$ (708.6), number of total spikelets (837.7), grain yield (4.64 t ha$^{-1}$) and straw yield (5.68 t ha$^{-1}$) were produced when the crop was fertilized with poultry manure at 2.5 t ha$^{-1}$ with 75% NPKS. It was revealed that fertilization with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS appeared to be the best among the fertilizer combinations studied for growing either of the Boro rice varieties. BRRI dhan29 in combination with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS appeared as the promising practice in Boro rice cultivation.*

**Key words:** Level of Poultry Manure, NPKS Fertilizers, BRRI dhan28, BRRI dhan29

## Introduction

Bangladesh is an agricultural country with plenty of water and suitable climatic condition for rice production. There are three rice growing seasons, namely *Aus, Aman* and *Boro* in Bangladesh. The majority of rice area is covered by *Aman* rice comprising 52% of the total rice area. *Boro* rice covers 35.69% of the total rice and it shares about 48.52% of the total rice production (BBS, 2003).Bangladesh earns about 23.46% of the gross domestic product (GDP) from agriculture (Kiron, 2003). Bangladesh is a densely populated country and at present its population growth rate is 1.48% (BBS, 2004). Its requirement for food is increasing at an alarming rate due to increasing population. Therefore, horizontal expansion of rice area is not

possible. The average yield of *Boro* rice is higher than that of *Aus* and *Aman* rice. For this *Boro* rice is important rice in our country. The use of improved variety and judicious fertilizer application can boost the yield of *Boro* rice. Yield and yield components of a particular crop are directly related to the variety and its environment in which it grows. Keeping this in view, scientists are working to evolve new varieties and technologies. Continuous efforts are being taken towards the development of new rice varieties to increase the yield per unit area and meet other requirements. BRRI dhan28 and BRRI dhan29 are two modern rice varieties suitable for cultivation in the *Boro* season. Integrated use of organic manures like poultry manure and NPKS fertilizers could give higher yield from these varieties. Nitrogen is one of the essential plant nutrients, which can augment the production of rice to a great extent. Application of urea-N gives good yield (BRRI, 1988) and urea has been found to be very effective nitrogenous fertilizer. Phosphorus is the second major nutrient for plant growth and it plays a critical role in the life cycle of plants. Phosphorus content of most of the Bangladesh soils is generally not adequate for good crop yield. Potassium is one of the primary and the third major food element for plant growth. Its function appears to be catalytic in nature and its deficiencies may greatly reduce crop yield. Sulphur is increasingly being recognized as the fourth major element for plant growth and it also plays a unique role in plant metabolism. In Bangladesh S deficiency in rice was first detected in BRRI farm, Joydebpur, Gazipur (Islam, 1978). Almost all soils of Bangladesh are deficient in nitrogen mainly due to low level of organic matter and its rapid decomposition due to warm climate, continuous intensive cropping, cultivation of high yielding varieties, and little or no adding of organic matter. Most of the soils of Bangladesh have less than 1.5% of organic matters and in some cases; it is less than 1%. Poultry manure may play a vital role in soil fertility improvement as well as supplying primary,

secondary and micronutrients for crop production. In addition, organic matter improves the physical, chemical and biological properties of soil and thus helps increase and conserves the soil productivity. In addition, global environmental pollution can be controlled considerably by reducing the use of fertilizer and increasing the use of manures. Moreover, suitable combination of organic and inorganic sources of nutrients is necessary for a sustainable agriculture that will provide food with good quality and maintain sound environment. The information of the effectiveness of combined use of poultry manure and chemical fertilizers on *Boro* rice is very meagre. The present investigation was, therefore, conducted with the following objectives. i) To observe the performance of two *Boro* rice varieties; ii) To find out the effect of combined application of poultry manure and NPKS fertilizers on yield of *Boro* rice and iii) To study the effect of interaction between variety and fertilizer on growth, yield and yield contributing characters of *Boro* rice.

## Materials and Methods

The experiment was carried out at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh, to evaluate the effect of combined level of poultry manure and NPKS fertilizers on the performance of *Boro* rice cv. BRRI dhan28 and BRRI dhan29. The experimental field is located at 24.75° N latitude and 90.50°E longitude at an average height of 18 m above the mean of sea level. The experimental site belongs to the Sonatola Soil Series under the Old Brahmaputra Floodplain Agro-Ecological Zone (AEZ-9). The experimental land was characterized by non-calcareous dark grey floodplain soils. The land was medium high and well drained with silty-loam texture. The soil of the experimental field was more or less neutral in reaction with pH value 6.82, low in organic matter content (1.19%) and the general fertility

level of the soil was also low. The experiment comprised two varieties of *Boro* rice viz. BRRI dhan28 and BRRI dhan29 and eight fertilizer management practices viz. $M_1$= Control (No poultry manure and NPKS fertilizers), $M_2$=100% NPKS (Recommended dose of Urea = 305 kg $ha^{-1}$, TSP = 76 kg $ha^{-1}$, MP =60 kg $ha^{-1}$, Gypsum = 30 kg $ha^{-1}$), $M_3$= Poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS, $M_4$= Poultry manure at 5 t $ha^{-1}$ + 50% NPKS, $M_5$= Poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS, $M_6$= Poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS, $M_7$= Poultry manure at 5 t $ha^{-1}$ + 75% NPKS, and $M_8$= Poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS. The experiment was laid out in a randomized complete block design with three replications. Each block was divided into 16 unit plots each having the size of 4.0 m × 2.5 m. Thus, the total numbers of unit plots were 48. The distance maintained between two unit plots was 0.50 m and between blocks was 1m. The bunds around individual plots were made tight enough to control water movement between plots. Treatments were randomly allocated in each block. Seeds of two rice varieties namely, BRRI dhan28 and BRRI dhan29 were collected from the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh. Healthy seeds were selected by specific gravity method and then sprouted by immersing in water in bucket for 24 hours. Then the seeds were taken out of water and kept thickly in gunny bag. After 48 hours the seeds started sprouting and sown after 72 hours in the nursery bed. Seeds of both varieties were sown gently and uniformly in the wet nursery beds. The experimental land was first opened with a tractor drawn disc plough. The land was then puddled thoroughly by ploughing and cross ploughing with country plough and subsequently levelled by laddering. Weed and stubble of the previous crop were collected and removed from the field. The field layout was done according to design immediately after final land preparation. The land was fertilized as per treatment specifications. At the time of final land preparation, each unit plot was fertilized with combined

level of poultry manure in the respective plots according to treatment. The poultry manure was mixed thoroughly with the soil. The amount of nitrogen, phosphorus, potassium, sulphur required for each unit plot was calculated on per hectare basis and applied in the form of urea, triple super phosphate, muriate of potash and gypsum, respectively. Urea was applied in three equal splits. The first split of urea and dose of triple super phosphate, muriate of potash and gypsum were applied at final land preparation as per treatment requirements. The second split of urea was top dressed after 30 days of transplanting and third split of urea after 50 days of transplanting. Nursery beds were made wet by application of water both in the morning and evening on the day before uprooting the seedlings. Seedlings were uprooted carefully from the nursery beds early in the morning and were kept on soft mud in shade to avoid mechanical injury to the roots. Forty five-day old seedlings were transplanted in the main field at the rate of 3 seedlings $hill^{-1}$ with 25 cm spacing between lines and 15 cm spacing between hills. Seedlings of some of the hills died off and were replaced by gap filling with healthy seedlings from the same source. Weeding was done twice. The first weeding was done at 30 days after transplanting (DAT). Thereafter, second split of urea was applied as top dressing on the same day. The second weeding was done at 50 DAT followed by third split of urea as top dressing. Flood irrigation was given to maintain a constant level of standing water up to 6 cm at the early stages to enhance tillering and 10-12cm at the later stage to discourage late tillering. Excess water was drained out from the plots before 15 days of harvest to enhance maturity of the crop. The crop was harvested at full maturity. Maturity of crops was determined when 90% of the grains became golden yellow colour. Five hills were randomly selected in each plot excluding border rows and uprooted before harvesting for recording the necessary data. In each plot central 2.5 m × 2.0 m area was harvested to record the yields of grain and straw. Five hills that

were randomly selected for measuring plant height and tiller production were used to record the data of yield contributing characters. The harvested crop of each plot was separately bundled, properly tagged and then brought to the threshing floor. The crop was threshed by pedal thresher. Grains were sun dried and cleaned. Straws were also sun dried properly. Finally, grain and straw yields were adjusted to 14% moisture and converted to ton per hectare. Growth study was started at 30 DAT and continued up to 60 DAT at 15 day intervals. Three hills plot$^{-1}$ was carefully uprooted randomly at each time for dry matter determination. Five hills were randomly selected in each plot excluding border hills and the harvest area to record the data on plant height and tillers hill$^{-1}$. Following yield and yield components related data were recorded i.e. Plant height (cm), Number of total tillers hill$^{-1}$, Number of effective tillers hill$^{-1}$, Number of non-effective tillers hill$^{-1}$, Panicle length (cm), Number of grains panicle$^{-1}$, Number of sterile spikelets panicle$^{-1}$, Number of total spikelets panicle$^{-1}$, Sterility percentage, 1000-grain weight (g), Grain yield (t ha$^{-1}$), Straw yield (t ha$^{-1}$), and Harvest index (%). The recorded data were compiled and tabulated in proper form for statistical analysis. Analysis of variance was done with the help of a computer package Programme MSTAT and the mean differences were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

## Results and Discussion

## Growth Parameters

### Plant height

Plant height was influenced significantly at 1% level of probability at 30 and 60 DAT, except 45 DAT. Plant height in both varieties increased progressively with the advancement of time from 30-60 DAT. At 30 DAT BRRI dhan29 produced taller plants than BRRI dhan28. This trend of result continued up to

45 and 60 DAT (Table 1). It might be due to genetic makeup of the variety. It was influenced significantly due to combined application of poultry manure and NPKS fertilizers. At 30 DAT, the highest plant height (46.76 cm) was observed in treatment $M_3$ (poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS) and the lowest one (42.18 cm) was obtained from $M_4$ (poultry manure at 5 t $ha^{-1}$ + 50% NPKS). The highest plant height (64.13 cm) was obtained in $M_6$ (poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS) and the lowest one (61.51 cm) was obtained in $M_1$ (control) at 45 DAT. At 60 DAT, the highest Plant height (73.45 cm) was obtained in $M_6$ (poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS) and the lowest one (65.30 cm) was found from $M_1$ (control) (Table 2). Plant height was significantly also influenced by the interaction effect of varieties and combined level of poultry manure and NPKS fertilizers at all dates of observation. At 30 DAT, the highest plant height (50.73 cm) was observed in BRRI dhan28 with poultry manure at 2.5 t $ha^{-1}$ +50% NPKS and the lowest one (41.96 cm) was found in BRRI dhan29 with poultry manure at 5 t $ha^{-1}$ + 75% NPKS. At 45 DAT the highest plant height (65.70 cm) was observed in BRRI dhan29 with poultry manure at 5 t $ha^{-1}$ + 50% NPKS and the lowest one (60.60 cm) was found in BRRI dhan28 with poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS. At 60 DAT, the highest plant height (74.06 cm) was found in BRRI dhan29 with poultry manure at 5 t $ha^{-1}$ + 50% NPKS and the lowest one (63.06 cm) was found in BRRI dhan28 with control (Table 3).

**Number of total tillers $hill^{-1}$**

**N**umber of total tillers $hill^{-1}$ was significantly influenced by the varieties, combined level of poultry manure and NPKS fertilizer and their interaction on the number of total tillers $hill^{-1}$ were significant at all dates of sampling. At 30 DAT, BRRI dhan29 produced higher number of total tillers $hill^{-1}$ than that of BRRI dhan28. Similar trend was found at 45 DAT and 60 DAT (Table 1). This might have occurred due to differences in genetic

makeup of the cultivars tested. At 30 DAT, the highest number of total tillers hill$^{-1}$ (10.45) was observed in $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) and the lowest number of total tillers hill$^{-1}$ (7.45) was found in $M_1$ (control). The highest number of total tillers hill$^{-1}$ (11.35) was observed in $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) and the lowest one (9.56) was found in $M_1$ (control) at 45 DAT. At 60 DAT, the maximum number of total tillers hill$^{-1}$ (12.08) was observed in $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) and the lowest one (10.35) was found in $M_3$ (poultry manure at 2.5 t ha$^{-1}$ + 50% NPKS) (Table 2). At 30 DAT, the highest number of total tillers hill$^{-1}$ (11.43) was found in BRRI dhan29 with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS and the lowest one (6.667) was found in BRRI dhan28 with control. At 45 DAT, the maximum number of total tillers hill$^{-1}$ (12.43) was observed in BRRI dhan29 with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS and the lowest one (7.467) was found in BRRI dhan28 with control. At 60 DAT, the highest number of total tillers hill$^{-1}$ (12.97) was found in BRRI dhan29 with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS and the lowest one (9.46) was found in BRRI dhan28 with control (Table 3).

**Total dry matter production**

Varieties had significant effect on total dry matter production of rice only at 60 DAT. At 60 DAT, higher total dry matter production (16.73g) was found in BRRI dhan29 than that of BRRI dhan28 (15.34g) (Table 1). Total dry matter was significantly influenced due to combined level of poultry manure and NPKS fertilizers at all dates of observation except at 30 DAT. At 45 DAT, the highest total dry matter (10.97g) was found in $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) and the lowest one (9.23g) was found in $M_1$ (control). At 60 DAT, the highest total dry matter (17.08g) was found in $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) and the lowest one (14.26g) was found in $M_3$ (poultry manure at 2.5 t ha$^{-1}$ + 50% NPKS) (Table 2). Total dry matter significantly influenced by the

interaction of varieties and combined level of poultry manure and NPKS fertilizers at 60DAT. At 60 DAT, the highest total dry matter (17.98g) was found in BRRI dhan29 with poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS and the lowest one (13.15 g) was found in BRRI dhan29 with poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS (Table 3).

**Table 1. Effect of varieties of *Boro* rice on plant height, number of total tillers $hill^{-1}$, total dry matter $hill^{-1}$ at different days after transplanting (DAT)**

| Varieties | Plant height (cm) | | | Number of total tillers $hill^{-1}$ | | | Total dry matter $plant^{-1}$ (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | 45 DAT | 60 DAT | 30 DAT | 45 DAT | 60 DAT | 30 DAT | 45 DAT | 60 DAT |
| BRRI dhan 28 | 44.22 | 62.76 | 69.32 | 8.73 | 9.783 | 10.64 | 5.45 | 10.15 | 16.348 |
| BRRI dhan 29 | 42.70 | 63.26 | 70.87 | 9.24 | 11.03 | 11.69 | 5.78 | 10.45 | 15.735 |
| Level of significance | ** | NS | ** | * | ** | ** | NS | NS | * |
| $s\bar{X}$ | 0.186 | 0.207 | 0.1881 | 0.170 | 0.161 | 0.1727 | 0.160 | 0.170 | 0.189 |
| CV% | 2.10 | 1.61 | 1.31 | 9.26 | 7.60 | 7.57 | 14.02 | 8.10 | 5.77 |

Figures in a column having similar letter (s) do not differ significantly at ≤ 0.05.

* Significant at $p \leq 0.05$.

** Significant at $p \leq 0.01$.

NS = Not significant.

**Table 2. Effect of combined level of poultry manure and NPKS fertilizers on plant height (cm), number of total tillers $hill^{-1}$ and total dry matter (g) $plant^{-1}$ of *Boro* rice at different days after transplanting (DAT)**

| Manure and inorganic fertilizer | Plant height (cm) | | | Number of total tillers $hill^{-1}$ | | | Total dry matter (g) $plant^{-1}$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | 45 DAT | 60 DAT | 30 DAT | 45 DAT | 60 DAT | 30 DAT | 45 DAT | 60 DAT |
| $M_1$ | 42.267cd | 61.51b | 65.30e | 7.45e | 9.56b | 11.20a-c | 4.91 | 9.23 | 15.22bc |
| $M_2$ | 42.68bc-d | 63.56a | 69.38c | 9.68a-c | 10.58ab | 10.90bc | 5.86 | 9.89 | 16.16ab |
| $M_3$ | 46.76a | 64.08a | 67.90d | 8.20de | 9.73b | 10.35c | 5.84 | 10.42 | 14.26c |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $M_4$ | 42.18d | 61.48b | 72.18b | 8.58d | 9.75b | 10.81bc | 5.51 | 9.84 | 15.91ab |
| $M_5$ | 43.53b | 61.95b | 69.25c | 9.81ab | 11.13a | 10.76bc | 5.73 | 11.15 | 16.62a |
| $M_6$ | 43.41bc | 64.13a | 73.45a | 10.45a | 11.35a | 12.08a | 5.74 | 10.97 | 17.08a |
| $M_7$ | 43.10b-d | 63.55a | 73.10ab | 9.06b-d | 10.41ab | 11.60ab | 6.00 | 10.89 | 16.59a |
| $M_8$ | 43.75b | 63.85a | 70.21c | 8.66cd | 10.53ab | 11.65ab | 5.33 | 10.00 | 16.46a |
| Level of significance | ** | ** | ** | ** | ** | * | NS | ** | ** |
| $S_{\bar{x}}$ | 0.372 | 0.4145 | 0.3764 | 0.33 | 0.3230 | 0.3454 | 0.3214 | 0.3405 | 0.3779 |

Mean values in a column having similar letter (s) do not differ significantly whereas mean values with dissimilar letter (s) differ significantly

* Significant at $p \leq 0.05$, ** Significant at $p \leq 0.01$ and NS = Not significant.

$M_1$ = Control (No poultry manure and NPKS fertilizers), $M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg ha$^{-1}$), $M_3$ = Poultry manure at 2.5 t ha$^{-1}$ + 50% NPKS, $M_4$ = Poultry manure at 5 t ha$^{-1}$ + 50% NPKS, $M_5$ = Poultry manure at 7.5 t ha$^{-1}$ + 50% NPKS, $M_6$ = Poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS, $M_7$ = Poultry manure at 5 t ha$^{-1}$ + 75% NPKS and $M_8$ = Poultry manure at 7.5 t ha$^{-1}$ + 75% NPKS

**Table 3. Effect of interaction of varieties and combined level of poultry manure and NPKS fertilizers on plant height, number of total tillers hill$^{-1}$ and total dry matter plant$^{-1}$ (g) of *Boro* rice at different days after transplanting (DAT)**

| Interaction | Plant height (cm) | | | Number of total tillers hill$^{-1}$ | | | Total dry matter plant$^{-1}$ (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| (V × M) | 30 DAT | 45 DAT | 60 DAT | 30 DAT | 45 DAT | 60 DAT | 30 DAT | 45 DAT | 60 DAT |
| $V_1 \times M_1$ | 42.50d-f | 62.46c-e | 63.06f | 6.667e | 7.46f | 9.46e | 4.90 | 8.88 | 15.03e |
| $V_1 \times M_2$ | 42.83c-f | 61.90c-e | 69.70b | 10.07ab | 10.73b-e | 11.10b-d | 5.62 | 9.39 | 15.84c-e |
| $V_1 \times M_3$ | 50.73a | 60.63e | 63.40e | 8.73b-d | 10.17b-e | 10.90b-e | 5.74 | 10.36 | 15.37de |
| $V_1 \times M_4$ | 41.90f | 61.20e | 70.30b | 7.70de | 9.33e | 10.07c-e | 5.39 | 9.39 | 15.28de |
| $V_1 \times M_5$ | 42.80c-f | 60.60e | 67.96c-e | 9.50bc | 10.73b-e | 11.20b-d | 5.63 | 10.91 | 17.78ab |
| $V_1 \times M_6$ | 44.66b | 65.56a | 73.07a | 8.73b-d | 9.66de | 9.80de | 5.66 | 10.71 | 16.61a-e |
| $V_1 \times M_7$ | 44.23b-d | 65.30a | 73.77a | 9.46bc | 10.37b-e | 11.07b-e | 5.45 | 11.07 | 15.19de |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $V_1 \times M_8$ | 44.10b-e | 64.46ab | 70.33b | 9.03b-d | 9.80c-e | 11.57a-c | 5.21 | 10.46 | 16.87a-d |
| $V_2 \times M_1$ | 42.03f | 61.76de | 67.53de | 8.23cd | 12.33a | 12.93a | 4.91 | 9.59 | 15.43de |
| $V_2 \times M_2$ | 42.53c-f | 65.23a | 69.06b-d | 9.30bc | 10.13b-e | 10.70b-e | 6.11 | 10.38 | 16.48a-e |
| $V_2 \times M_3$ | 42.80c-f | 62.40c-e | 69.40bc | 7.66de | 9.30e | 9.80de | 5.94 | 10.47 | 13.15f |
| $V_2 \times M_4$ | 42.46ef | 65.70a | 74.06a | 9.46bc | 9.80c-e | 11.57ab | 5.64 | 10.30 | 16.54a-e |
| $V_2 \times M_5$ | 44.26bc | 63.30b-d | 70.53b | 10.13ab | 11.53ab | 12.13ab | 5.84 | 11.38 | 15.47de |
| $V_2 \times M_6$ | 42.16f | 62.13c-e | 73.83a | 11.43a | 12.43a | 12.97a | 5.81 | 11.24 | 17.98a |
| $V_2 \times M_7$ | 41.96f | 61.80de | 72.43a | 9.40bc | 11.16a-d | 11.73ab | 6.54 | 10.71 | 17.56a-c |
| $V_2 \times M_8$ | 43.40b-f | 63.80a-c | 70.10b | 8.30cd | 11.26a-c | 11.73ab | 5.44 | 9.55 | 16.05b-e |
| Level of significance | ** | ** | ** | * | ** | ** | NS | NS | ** |
| $s_{\bar{x}}$ | 0.526 | 0.586 | 0.532 | 0.4808 | 0.456 | 0.488 | 0.4546 | 0.4815 | 0.5346 |

Mean values in a column having the similar letter(s) do not differ significantly whereas mean values having dissimilar letter(s) differ significantly as per DMRT.

* Significant at $p \leq 0.05$, ** Significant at $p \leq 0.01$ and NS = Not significant.

$C_1$ = BRRI dhan 28 and $C_2$ = BRRI dhan 29

$M_1$ = Control (No poultry manure and NPKS fertilizers), $M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg $ha^{-1}$), $M_3$ = Poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS, $M_4$ = Poultry manure at 5 t $ha^{-1}$ + 50% NPKS, $M_5$ = Poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS, $M_6$ = Poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS, $M_7$ = Poultry manure at 5 t $ha^{-1}$ + 75% NPKS and $M_8$ = Poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS.

## Yield and Yield Components at Harvest

## Plant height

Varieties exerted positive effect on the plant height at 1% level of probability. Plant height of BRRI dhan29 (81.38cm) was higher than BRRI dhan28 (69.93) at harvest (Fig. 1 and

Appendix I). These differences prevailed due to the genetic variation between the variety. The results are agreement with that of Sawant *et al*. (1986) and Shamsuddin *et al*. (1988) who recorded variable plant height among varieties.

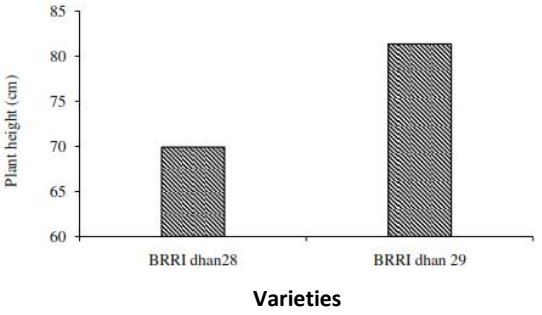


**Fig. 1 Effects of cultivar on plant height at harvest**

Plant height was significantly affected due to combined level of poultry manure and NPKS fertilizers at 1% level of probability. Fig.2 and Appendix II indicated that plant reached the maximum height (79.66 cm) in $M_7$ (poultry manure at 5 t $ha^{-1}$ + 75% NPKS), which was statistically identical to $M_8$ (poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS) and the lowest one (67.41 cm) was observed in $M_1$ (control). The present study showed that plant height increased due to application of poultry manure and inorganic fertilizer. The results are agreement with that of Sharma and Mitra (1991), Azim (1999).

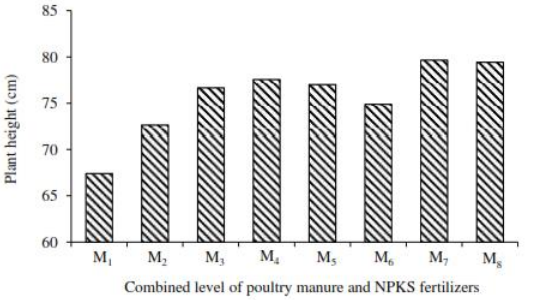

**Fig.2 Effect of combined level of poultry manure and NPKS fertilizers on plant height at harvest**

$M_1$ = Control (No poultry manure and NPKS fertilizers),
$M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg $ha^{-1}$),
$M_3$ = Poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS,
$M_4$ = Poultry manure at 5 t $ha^{-1}$ + 50% NPKS,
$M_5$ = Poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS,
$M_6$ = Poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS,
$M_7$ = Poultry manure at 5 t $ha^{-1}$ + 75% NPKS and
$M_8$ = Poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS

The interaction of varieties and combined level of poultry manure and NPKS fertilizers significantly affected plant height at 1% level of probability. Plant height ranged from 58.74 cm to 87.11 cm indicated that the tallest plant (87.11 cm) was obtained from combination of BRRI dhan29 with poultry manure at 5 t $ha^{-1}$ + 75% NPKS, which was statistically identical to BRRI dhan29 with poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS. The lowest one (58.74 cm) was observed in BRRI dhan28 with control (Table 6).

## Total tillers $hill^{-1}$

Number of total tillers $hill^{-1}$ was not significantly influenced by varieties. BRRI dhan28 produced magnitudianlly higher number of total tillers $hill^{-1}$ (13.69) than that of BRRI dhan29 (13.44) (Table 4).The variation in number of total tillers $hill^{-1}$ occurred due to differences in their genetic makeup. Variable effect of varieties on number of total tillers $hill^{-1}$ was also recorded by Hossain *et al.* (1991) who reported that number of total tillers $hill^{-1}$ were different among the varieties. It was significantly influenced due to combined application of poultry manure and NPKS fertilizers at 1% level of probability. Number of total tillers $hill^{-1}$ ranged from 10.88 to 14.90. Table 5 showed that maximum number of total tillers $hill^{-1}$ (14.90) was observed in $M_6$ (poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS), which was statistically identical to $M_2$ (100% NPKS), $M_4$

(poultry manure at 5 t $ha^{-1}$ + 50% NPKS), $M_8$ (poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS) and the minimum (10.88) was observed in $M_1$ (control). Total tillers $hill^{-1}$ was significantly influenced by the interaction of varieties and combined level of poultry manure and NPKS fertilizers at 1% level of probability. The highest number of total tillers $hill^{-1}$ (16.93) was observed in BRRI dhan28 with poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS, which was statistically identical to BRRI dhan28 with poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS and the lowest number of total tillers $hill^{-1}$ (10.10) was observed in BRRI dhan28 with control, BRRI dhan28 with poultry manure at 5 t $ha^{-1}$ + 50% NPKS, BRRI dhan29 with 100% NPKS, BRRI dhan29 with poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS (Table 6). The progressive improvement in the formation of tillers with combination of recommended inorganic fertilizer level might be due to much availability of nitrogen that enhanced tillering. Ahmed and Rahman (1991) found that organic and chemical fertilizers increased tiller number.

**Effective tillers $hill^{-1}$**

Varieties exerted non-significant influence on effective tillers $hill^{-1}$. The results indicated that numerically higher number of effective tillers $hill^{-1}$ was produced by BRRI dhan28 (10.62) compared to BRRI dhan29 (Fig. 3 and Appendix I). The differences occurred due to the hereditary influence of the variety. These findings are in agreement with that of Chowdhury *et al*. (1993), who stated that effective tillers $hill^{-1}$ varied with variety.

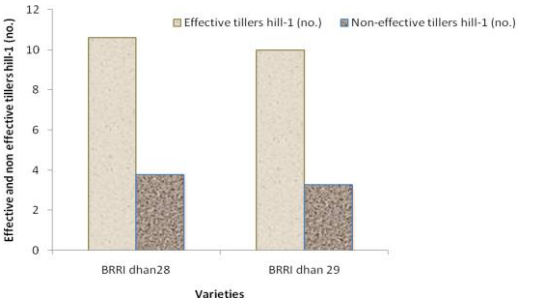


**Fig.3 Effect of cultivar on effective and non-effective tillers hill$^{-1}$ at harvest**

Number of effective tillers hill$^{-1}$ was significantly influenced due to combined level of poultry manure and NPKS fertilizers at 1% level of probability. The maximum number of effective tillers hill$^{-1}$ (11.71) was observed in $M_8$ (poultry manure at 7.5 t ha$^{-1}$ + 75% NPKS) which was statistically identical with $M_4$, $M_3$ and $M_5$. The lowest one (9.16) was found in $M_1$ (control) (Fig. 4 and Appendix II).

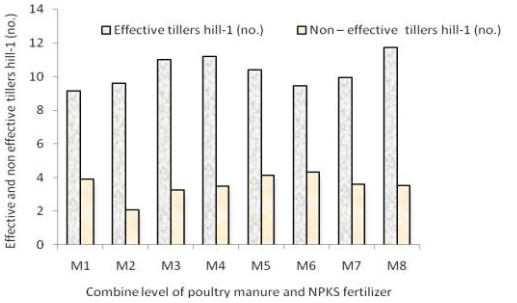


**Fig.4 Effect of combined level of poultry manure and NPKS fertilizers on effective and non-effective tillers hill$^{-1}$ at harvest**

$M_1$ = Control (No poultry manure and NPKS fertilizers),
$M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg ha$^{-1}$),
$M_3$ = Poultry manure at 2.5 t ha$^{-1}$ + 50% NPKS,
$M_4$ = Poultry manure at 5 t ha$^{-1}$ + 50% NPKS,
$M_5$ = Poultry manure at 7.5 t ha$^{-1}$ + 50% NPKS,
$M_6$ = Poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS,
$M_7$ = Poultry manure at 5 t ha$^{-1}$ + 75% NPKS and
$M_8$ = Poultry manure at 7.5 t ha$^{-1}$ + 75% NPKS

Number of effective tillers hill$^{-1}$ was not significantly influenced by the interaction of cultivars and combined level of poultry manure and NPKS fertilizers. But numerically the highest number of effective tillers hill$^{-1}$ (12.40) was obtained from BRRI dhan28 with poultry manure at 2.5 t ha$^{-1}$ + 50% NPKS and the lowest effective tillers hill$^{-1}$ (8.60) was found from BRRI dhan28 with control (Table 6). The present findings are agreement with that of Apostol (1989) who found that organic and inorganic fertilizers increased productive tillers hill$^{-1}$.

**Number of non- effective tillers hill$^{-1}$**

The result showed that number of non-effective tillers hill$^{-1}$ was not significantly influenced by cultivars. Higher number of non-effective tillers hill$^{-1}$ (3.78) was obtained from BRRI dhan28 than that of BRRI dhan29 (3.28) (Fig. 3 and Appendix I). Non-effective tillers hill$^{-1}$ was not significantly influenced due to combined application of poultry manure and NPKS fertilizers. Apparently the highest number of non-effective tillers hill$^{-1}$ (4.328) was found in $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) and the lowest one (2.065) was found in $M_2$ (100% NPKS) (Fig. 4 and Appendix II). Non-effective tillers hill$^{-1}$ was not significantly influenced by the interaction of cultivars and combined level of poultry manure and NPKS fertilizers. Numerically the highest number of non-effective tillers hill$^{-1}$ (5.32) was found in BRRI dhan28 with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS and the lowest one (1.33) was found in BRRI dhan29 with 100% NPKS (Table 6).

**Length of panicle**

It was observed that variety had significant influence on length of panicle at 5% level of probability. Higher panicle length (19.44 cm) was found in BRRI dhan29 than that of BRRI dhan28 (18.38 cm) (Table 4). These results are in agreement with that of Idris and Matin (1990) who reported that panicle length showed variation among the varieties. The variation

demonstrated that genetic characteristics were not at par regarding length of panicle. Length of panicle was not significantly influenced due to combined level of poultry manure and NPKS fertilizers. Apparently the highest panicle length (20.35 cm) was found in $M_6$ (poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS) and the lowest one (17.98 cm) was found in $M_1$ (control) (Table 5). Similar results on length of panicle due to fertilizer doses have also been reported by Nossai and Vargas (1982) who found that shorter panicle length was produced in the lower doses of fertilizers. Length of panicle was not significantly influenced by the interaction of varieties and combined level of poultry manure and NPKS fertilizers. Numerically the highest panicle length (21.62 cm) was found in BRRI dhan29 with poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS and the shortest (17.66 cm) one was found in BRRI dhan28 with poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS (Table 6).

**Number of grains panicle$^{-1}$**

Number of grains panicle$^{-1}$ was significantly affected by varieties, combined application of poultry manure and NPKS fertilizers. BRRI dhan28 produced higher number of grains panicle$^{-1}$ (590.49) than BRRI dhan29 (556.01) (Table 4). Singh and Gangawer (1989) reported variable number of grains panicle$^{-1}$ among varieties. Varietals differences regarding grains panicle$^{-1}$ production due to their difference in genetic constituents. Number of grains panicle$^{-1}$ was observed to increase due to combined level of poultry manure and NPKS fertilizers. The highest number of grains panicle$^{-1}$ (708.6) was observed in $M_6$ (poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS) and the lowest one (374.2) was found in $M_1$ (control) (Table 5). The data also revealed that higher dose of nitrogen and potassium gave better results from the sources of organic and inorganic fertilizer. The findings in an agreement with that of Mondal *et al*. (1989) who reported that the increasing rates of N and K increased the number of grains panicle$^{-1}$. This result is in

conformity with the findings of Chander and Pandey (1996) who reported that increasing doses of NPK fertilizers increased the number of grains panicle$^{-1}$. Number of grains panicle$^{-1}$ was also significantly influenced at 1% level of probability by the interaction of cultivars and combined level of poultry manure and NPKS fertilizers. The highest number of grains panicle$^{-1}$ (767.7) was produced by the combination of BRRI dhan29 with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS and the lowest number (311.1) of grains panicle$^{-1}$ was produced by BRRI dhan28 with control (Table 6).

**Number of sterile spikelets panicle$^{-1}$**

Among the undesirable characters, number of sterile spikelets panicle$^{-1}$ is the most significant and plays vital role in yield reduction. The effect of varieties on sterile spikelets panicle$^{-1}$ was statistically significant at 1% level of probability. Table 4 showed that higher number of sterile spikelets panicle$^{-1}$ was found in BRRI dhan29 (137.85) whereas lower number of sterile spikelets panicle$^{-1}$ (99.03) was obtained from BRRI dhan28. Chowdhury *et al*. (1993) and BINA (1993) also reported differences in number of sterile spikelets panicle$^{-1}$ due to varietals differences. This variation might be due to genetic characteristics of the varieties. Number of sterile spikelets panicle$^{-1}$ was significantly affected due to combined application of poultry manure and NPKS fertilizers at 1% level of probability. The highest number of sterile spikelets panicle$^{-1}$ (144.0) was found in $M_5$ (poultry manure at 7.5 t ha$^{-1}$ + 50% NPKS) and the lowest one (93.73) was found in $M_1$ i.e. control (Table 5). Sterile spikelets panicle$^{-1}$ was significantly affected due to the interaction of varieties and combined level of poultry manure and NPKS fertilizers at 1% level of probability. The highest number of sterile spikelets panicle$^{-1}$ (182.50) was found in BRRI dhan29 with poultry manure at 7.5 t ha$^{-1}$ + 50% NPKS and the lowest (76.60) sterile spikelets panicle$^{-1}$ was found in BRRI dhan28 with control (Table 6).

**Total spikelets panicle$^{-1}$**

The effect of varieties on number of total spikelets panicle$^{-1}$ was not significant. Numerically the maximum number of total spikelets panicle$^{-1}$ (693.86) was produced in BRRI dhan29 and the minimum number of (689.52) was produced BRRI dhan28 (Table 4). Number of total spikelets panicle$^{-1}$ was significantly influenced at 1% level of probability due to combined application of poultry manure and NPKS fertilizers. The highest number of total spikelets panicle$^{-1}$ (837.7) was found in $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) followed in order by $M_8$, $M_7$, $M_4$, $M_3$, $M_2$, and $M_1$ treatments (Table 5). The interaction between varieties and combined level of poultry manure and NPKS fertilizers significantly influenced the total spikelets panicle$^{-1}$ at 1% level of probability (Appendix IV).The highest number of total spikelets panicle$^{-1}$ (880.5) was found in BRRI dhan28 with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS and the lowest one (387.7) was found in BRRI dhan28 with control (Table 6).

**Weight of 1000 grains**

Varieties differed significantly at 1% level of probability regarding weight of 1000 grains. Table 4 showed that BRRI dhan29 ranked first (24.74) in respect of 1000 grain weight while the second one (21.65) was produced by BRRI dhan28. Shamsuddin *et al*. (1988) and Chowdhury *et al*. (1993) reported that weight of 1000 grains varied in different varieties of rice. Weight of 1000 grains was not significantly affected due to combined application of poultry manure and NPKS fertilizers. However, apparently the highest 1000 grain weight (24.82 g) was found in $M_2$ (100% NPKS) and the lowest 1000 grain weight (22.54 g) was found in $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) (Table 5). Weight of 1000 grains was significantly affected by the interaction between cultivars and combined level of poultry manure and NPKS fertilizers. The highest 1000 grain weight (27.97 g) was found in BRRI dhan29 with 100%

NPKS and the lowest 1000 grain weight (20.49 g) was found in BRRI dhan28 with poultry manure at 5 t $ha^{-1}$ + 50% NPKS (Table 6).

**Sterility percentage**

Varieties, combined application of poultry manure and NPKS fertilizers and their interaction showed significant variation at 1% level of probability on sterility percentage. Table 4 indicates that higher sterility percentage (19%) was obtained in BRRI dhan29 compared to BRRI dhan28 mainly due to their different genetic makeup. The highest sterility percentage (20.74%) was found in $M_5$ (poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS), which was statistically identical to $M_1$ (control) followed in order by $M_2$, $M_3$, $M_8$, $M_7$, $M_6$ and $M_4$ treatments. The lowest sterility percentage was found in $M_4$ (poultry manure at 5 t $ha^{-1}$ + 50% NPKS) (Table 5). The highest number of sterility percentage (26.05%) was found in BRRI dhan29 with poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS and the lowest (11.43%) sterility percentage was found in BRRI dhan28 with poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS (Table 6).

**Grain yield**

Varieties and combined application of poultry manure and NPKS fertilizers exhibited significant effect at 1% level of probability regarding grain yield. It was observed that BRRI dhan29 produced higher grain yield (4.33 t $ha^{-1}$) than BRRI dhan28 (3.47 t $ha^{-1}$) (Fig. 5 and Appendix I). Higher plant height, higher length of panicle and higher weight of 1000 grains and higher number of total spikelets $panicle^{-1}$ obtained in BRRI dhan29 were mainly responsible for its higher grain yield compared to BRRI dhan28. Different grain yield among varieties were also reported by Suprithatro and Sutaryo (1992), Leenakumari *et al*. (1993) and Prashad and Umar (1993) who recorded variable grain yield among varieties. Present results showed that BRRI dhan29 was the most proliferous variety.

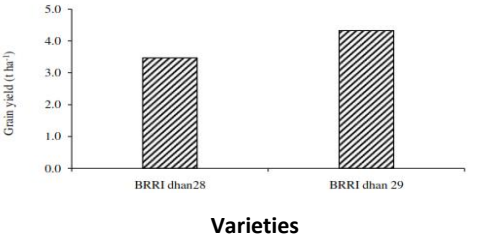


**Fig.5 Effect of cultivar on grain yield (t ha$^{-1}$) at harvest**

The highest grain yield (4.64 t ha$^{-1}$) was obtained in treatment $M_6$ (poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS) and which was statistically identical to $M_8$, $M_4$, $M_7$, $M_5$ and $M_3$. The lowest grain yield (2.54 t ha$^{-1}$) was found in $M_1$ (control) (Fig. 6 and Appendix II). It was interesting to note that application of poultry manures at 2.5 t ha$^{-1}$ + 50% NPKS was as good as other combinations of various proportions of NPKS and poultry manure and superior to sole application of NPKS fertilizers. This means that about 50% NPKS fertilizers can be reduced by application of 2.5 t ha$^{-1}$ poultry manures. This result also indicated that combined sources of nitrogen, phosphorus potassium and sulphur gave higher yield over sole application of inorganic fertilizer. The results of the present experiment are in conformity with the findings of BRRI (1988), Adhikary and Rahman (1996). Increase in grain yield due to combined application of poultry manure and NPKS fertilizers was mainly due to improvement in yield components viz. number of effective tillers hill$^{-1}$, panicle length, higher number of total spikelets panicle$^{-1}$ and 1000-grain weight.

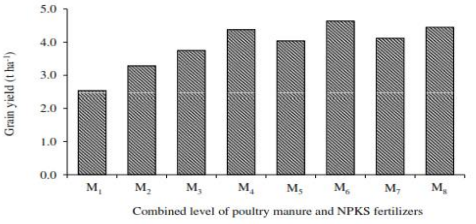

**Fig.6 Effect of combined level of poultry manure and NPKS fertilizers on grain yield (t ha$^{-1}$) at harvest**

$M_1$ = Control (No poultry manure and NPKS fertilizers),
$M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg ha$^{-1}$),
$M_3$ = Poultry manure at 2.5 t ha$^{-1}$ + 50% NPKS,
$M_4$ = Poultry manure at 5 t ha$^{-1}$ + 50% NPKS,
$M_5$ = Poultry manure at 7.5 t ha$^{-1}$ + 50% NPKS,
$M_6$ = Poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS,
$M_7$ = Poultry manure at 5 t ha$^{-1}$ + 75% NPKS and
$M_8$ = Poultry manure at 7.5 t ha$^{-1}$ + 75% NPKS

Effect of interaction between varieties and combined level of poultry manure and NPKS fertilizers on grain yield was not significant. The highest grain yield (5.867 t ha$^{-1}$) was found in BRRI dhan29 with poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS and the lowest (1.917 t ha$^{-1}$) grain yield was obtained in BRRI dhan28 with control (Table 6).

### 4.2.12 Straw yield

Straw yield was significantly influenced by varieties. Higher straw yield was (5.32 t ha$^{-1}$) produced by BRRI dhan29 and lower one (4.04 t ha$^{-1}$) was produced by BRRI dhan28 (Fig. 7 and Appendix I). Taller plant and higher number of total tillers hill$^{-1}$ mainly contributed to the higher straw yield of BRRI dhan29. This finding is in full agreement with that reported by Chowdhury *et al*. (1993) who found differences in straw yield among varieties.

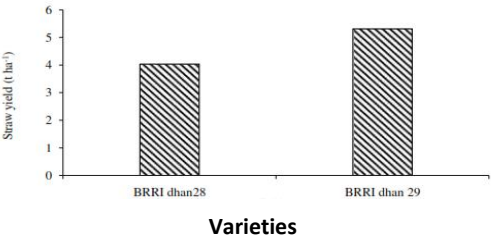


**Fig.7 Effect of cultivar on straw yield (t ha$^{-1}$) at harvest**

Straw yield was significantly influenced at 1% level of probability due to combined level of poultry manure and NPKS fertilizers. The highest straw yield (5.68 t $ha^{-1}$) was found in $M_6$ (poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS), which was statistically identical to $M_8$ (poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS) and $M_7$ (poultry manure at 5 t $ha^{-1}$ + 75% NPKS). The lowest (3.41 t $ha^{-1}$) straw yield was achieved from $M_1$ (control) (Fig. 8 and Appendix II). It was noted that straw yield in poultry manure at 2.5 t $ha^{-1}$ with 50% NPKS was as good as higher than that of sole application of NPKS fertilizers.

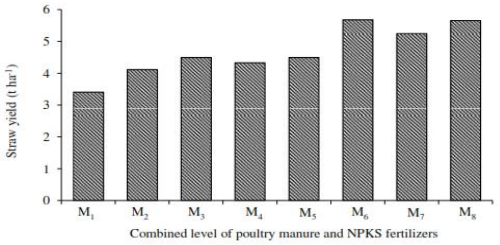


**Fig.8 Effect of combined level of poultry manure and NPKS fertilizers on straw yield (t $ha^{-1}$) at harvest**

$M_1$ = Control (No poultry manure and NPKS fertilizers),
$M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg $ha^{-1}$),
$M_3$ = Poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS,
$M_4$ = Poultry manure at 5 t $ha^{-1}$ + 50% NPKS,
$M_5$ = Poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS,
$M_6$ = Poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS,
$M_7$ = Poultry manure at 5 t $ha^{-1}$ + 75% NPKS and
$M_8$ = Poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS

Straw yield was not significant due to interaction of varieties and combined level of poultry manure and NPKS fertilizers. Apparently the highest straw yield (6.70 t $ha^{-1}$) was obtained from BRRI dhan28 with poultry manure at 7.5 t $ha^{-1}$ + 75% NPKS and the lowest straw yield (2.667 t $ha^{-1}$) was achieved from BRRI dhan28 with control (Table 6).

**Table 4. Effects of varieties on yield and yield components of *Boro* rice at harvest**

| Varieties | Total tillers hill$^{-1}$(no.) | Length of panicle (cm) | Grains panicle$^{-1}$ (no.) | Sterile spikelets panicle$^{-1}$ (no.) | Total spikelets panicle$^{-1}$ (no.) | 1000-grain weight (g) | Sterility (%) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|
| BRRI dhan28 | 13.69 | 18.38 | 590.49 | 99.03 | 689.52 | 21.65 | 14.00 | 45.79 |
| BRRI dhan 29 | 13.44 | 19.44 | 556.01 | 137.85 | 693.86 | 24.74 | 19.00 | 45.10 |
| Level of significance | NS | * | ** | ** | NS | ** | ** | NS |
| $S_{\bar{X}}$ | 0.223 | 0.297 | 3.243 | 0.593 | 3.141 | 0.429 | 0.1537 | 0.877 |
| CV (%) | 8.08 | 7.70 | 2.77 | 2.45 | 2.22 | 6.36 | 4.31 | 9.46 |

* Significant at $p \leq 0.05$.

** Significant at $p \leq 0.01$.

NS = Not significant.

**Table 5. Effect of combined level of poultry manure and NPKS fertilizers on yield and yield components of *Boro* rice at harvest**

| Poultry manure and inorganic fertilizers (NPKS) | Total tillers hill$^{-1}$ (no.) | Length of panicle (cm) | Grains panicle$^{-1}$ (no.) | Sterile spikelets panicle$^{-1}$ (no.) | Total spikelets panicle$^{-1}$ (no.) | 1000-grain weight (g) | Sterility (%) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|
| $M_1$ | 10.88e | 17.98 | 374.2f | 93.73f | 467.90f | 23.33 | 19.99a | 42.86 |
| $M_2$ | 14.70ab | 19.34 | 470.60e | 104.40e | 575.00e | 24.82 | 18.05b | 44.16 |
| $M_3$ | 13.00cd | 18.58 | 602.40c | 121.50c | 723.90c | 22.62 | 17.30b | 45.28 |
| $M_4$ | 14.57ab | 18.50 | 628.90b | 107.70e | 736.50bc | 24.08 | 15.10c | 50.10 |
| $M_5$ | 13.47bcd | 18.32 | 548.20d | 144.00a | 692.20d | 22.58 | 20.74a | 47.22 |
| $M_6$ | 14.90a | 20.35 | 708.6a | 129.10b | 837.70a | 22.54 | 15.55c | 44.44 |
| $M_7$ | 12.70d | 18.58 | 629.40b | 117.00d | 746.30b | 22.86 | 15.66c | 44.16 |
| $M_8$ | 14.33abc | 19.62 | 623.80b | 130.30b | 754.00b | 22.76 | 17.26b | 45.21 |
| Level of significance | ** | NS | ** | ** | ** | NS | ** | NS |
| $S_{\bar{X}}$ | 0.4476 | 0.594 | 6.486 | 1.187 | 6.283 | 0.6021 | 0.3074 | 1.754 |

Mean values in a column having the similar letter(s) do not differ significantly whereas mean values having dissimilar letter(s) differ significantly as per DMRT.

* Significant at $p \leq 0.05$.

** Significant at $p \leq 0.01$.

NS = Not significant.

$M_1$ = Control (No poultry manure and NPKS fertilizers), $M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg ha$^{-1}$), $M_3$ = Poultry manure at 2.5 t ha$^{-1}$ + 50% NPKS, $M_4$ = Poultry manure at 5 t ha$^{-1}$ + 50% NPKS, $M_5$ = Poultry manure at 7.5 t ha$^{-1}$ + 50% NPKS, $M_6$ = Poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS, $M_7$ = Poultry manure at 5 t ha$^{-1}$ + 75% NPKS and $M_8$ = Poultry manure at 7.5 t ha$^{-1}$ + 75% NPKS.

**Table 6. Interaction effects of varieties (V) and combined level of poultry manure and NPKS fertilizers (M) on yield and yield components of *Boro* rice at harvest**

| Interaction (V×M) | Plant height at harvest (cm) | Total tillers hill$^{-1}$ (no.) | Effective tillers hill$^{-1}$ (no.) | Non-effective tillers hill$^{-1}$ (no.) | Length of panicle (cm) | Grains panicle$^{-1}$ (no.) | Sterile spikelets panicle$^{-1}$ (no.) | Total spikelets panicle$^{-1}$ (no.) | 1000-grain weight (g) | Sterility (%) | Grain yield (t ha$^{-1}$) | Straw yield (t ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $V_1 \times M_1$ | 58.74 h | 10.10 g | 8.60 | 3.63 | 17.90 | 311.1 j | 76.60 k | 387.7 l | 21.36 e | 19.76 cd | 1.917 | 2.667 | 41.87 |
| $V_1 \times M_2$ | 68.01 g | 13.06 cde | 9.73 | 2.79 | 18.54 | 418.3 i | 86.93 j | 505.2 k | 21.67 de | 17.20 f | 2.833 | 3.333 | 45.15 |
| $V_1 \times M_3$ | 69.10 fg | 15.20 ab | 12.40 | 4.13 | 17.66 | 690.6 c | 89.10 j | 779.7 cd | 20.49 e | 11.43 i | 3.500 | 4.000 | 46.62 |
| $V_1 \times M_4$ | 72.95 de | 15.27 ab | 11.93 | 2.47 | 18.18 | 738.9 b | 96.10 i | 835.0 b | 22.98 bcde | 11.51 i | 4.513 | 3.833 | 54.24 |
| $V_1 \times M_5$ | 71.23 efg | 14.20 bc | 10.80 | 4.52 | 18.12 | 578.4 g | 105.5 h | 683.9 fg | 20.63 e | 15.42 g | 3.917 | 4.333 | 47.39 |
| $V_1 \times M_6$ | 70.88 efg | 16.93 a | 9.93 | 5.32 | 19.08 | 767.7 a | 112.9 f | 880.5 a | 21.77 cde | 12.82 h | 3.417 | 4.667 | 42.20 |
| $V_1 \times M_7$ | 72.21 ef | 12.73 cdef | 10.46 | 4.08 | 18.37 | 587.7 g | 107.3 gh | 694.5 fg | 23.17 bcde | 15.43 g | 3.583 | 4.500 | 44.30 |
| $V_1 \times M_8$ | 76.34 cd | 12.07 defg | 11.08 | 3.31 | 19.20 | 631.3 ef | 117.9 e | 749.3 e | 21.21 e | 15.74 g | 4.083 | 5.000 | 44.57 |
| $V_2 \times M_1$ | 76.08 cd | 11.66 efg | 9.73 | 4.17 | 18.06 | 437.3 i | 110.9 fg | 548.1 j | 25.30 b | 20.23 c | 3.167 | 4.167 | 43.86 |
| $V_2 \times M_2$ | 77.30 c | 16.33 a | 9.46 | 1.33 | 20.15 | 523.0 h | 121.8 e | 644.8 hi | 27.97 a | 18.90 de | 3.750 | 4.917 | 43.18 |
| $V_2 \times M_3$ | 84.23 ab | 10.80 fg | 9.60 | 2.40 | 19.50 | 514.2 h | 153.9 b | 668.1 gh | 24.76 b | 23.18 b | 4.000 | 5.000 | 44.14 |
| $V_2 \times M_4$ | 82.16 b | 13.87 bcd | 10.46 | 4.52 | 18.82 | 518.8 h | 119.2 e | 638.1 i | 25.20 b | 18.69 de | 4.250 | 4.833 | 45.97 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $V_2 \times M_5$ | 82.82 b | 12.73 cdef | 9.96 | 3.71 | 18.52 | 518.8 h | 182.5 a | 700.4 f | 24.54 bc | 26.05 a | 4.167 | 4.667 | 47.05 |
| $V_2 \times M_6$ | 78.87 c | 12.87 cdef | 9.00 | 3.33 | 21.62 | 649.5 de | 145.3 c | 794.19 c | 23.32 bcde | 18.28 ef | 5.867 | 6.700 | 46.68 |
| $V_2 \times M_7$ | 87.11 a | 12.67 cdef | 9.40 | 3.13 | 18.80 | 671.1 cd | 126.7 d | 797.8 c | 22.56 bcde | 15.88 g | 4.667 | 6.000 | 44.03 |
| $V_2 \times M_8$ | 81.51 b | 16.60 a | 12.33 | 3.70 | 20.05 | 616.2 f | 142.6 c | 758.8 de | 24.32 bcd | 18.79 de | 4.833 | 6.333 | 45.86 |
| Level of significance | ** | ** | NS | NS | NS | ** | ** | ** | * | ** | NS | NS | NS |
| $\bar{x}$ | 1.134 | 0.6330 | 0.633 | 0.737 | 0.8410 | 9.173 | 1.678 | 8.885 | 0.8515 | 0.4347 | 0.4911 | 0.4158 | 2.4816 |

Mean values in a column having the similar letter(s) do not differ significantly whereas mean values having dissimilar letter(s) differ significantly as per DMRT. * Significant at $p \leq 0.05$, ** Significant at $p \leq 0.01$ and NS = Not significant.

$V_1$ = BRRI dhan28 and $V_2$ = BRRI dhan29

$M_1$ = Control (No poultry manure and NPKS fertilizers), $M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg ha$^{-1}$), $M_3$ = Poultry manure at 2.5 t ha$^{-1}$ + 50% NPKS, $M_4$ = Poultry manure at 5 t ha$^{-1}$ + 50% NPKS, $M_5$ = Poultry manure at 7.5 t ha$^{-1}$ + 50% NPKS, $M_6$ = Poultry manure at 2.5 t ha$^{-1}$ + 75% NPKS, $M_7$ = Poultry manure at 5 t ha$^{-1}$ + 75% NPKS and $M_8$ = Poultry manure at 7.5 t ha$^{-1}$ + 75% NPKS

## Harvest index

Harvest index was not significantly affected by varieties, combined level of poultry manure and NPKS fertilizers and their interaction. BRRI dhan28 gave higher harvest index (45.79%) than BRRI dhan29 (45.10%) (Table 4). However, numerically the highest harvest index (50.10%) was obtained from $M_4$ (poultry manure at 5 t ha$^{-1}$ + 50% NPKS) and the lowest harvest index (42.86%) was found in $M_1$ (control) (Table 5). Numerically, the highest harvest index (54.24%) was found in BRRI dhan28 with poultry manure at 5 t ha$^{-1}$ + 50% NPKS and the lowest harvest index (41.87%) was found in BRRI dhan28 with control (Table 6). From the above results and discussion it is clear that variety BRRI dhan29 is superior to BRRI dhan28 in respect of grain yield. The treatment poultry manure at 2.5 t ha$^{-1}$ with 75% NPKS produced the highest

grain yield. Among the interaction treatments BRRI dhan29 with poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS combination produced the highest grain yield**.** Application of poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS fertilizer appeared as the superior practice to sole application of NPKS fertilizers, which indicated that 50% NPKS fertilizers could be saved in *Boro* rice culture.

## Appendix I. Effects of varieties on yield and yield components of *Boro* rice at harvest

| Varieties | Plant height at harvest (cm) | Effective tillers $hill^{-1}$ (no.) | Non-effective tillers $hill^{-1}$ (no.) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
|---|---|---|---|---|---|
| BRRI dhan28 | 69.93b | 10.62a | 3.78a | 3.47b | 4.04b |
| BRRI dhan 29 | 81.38a | 9.99b | 3.28b | 4.33a | 5.32a |
| Level of significance | ** | NS | NS | ** | ** |
| $S_{\bar{X}}$ | 0.8017 | 0.4481 | 0.5215 | 0.3471 | 0.2941 |

** Significant at $p \leq 0.01$.
NS = Not significant.

## Appendix II. Effect of combined level of poultry manure and NPKS fertilizers on yield and yield components of *Boro* rice

| Poultry manure and inorganic fertilizers (NPKS) | Plant height at harvest (cm) | Effective tillers $hill^{-1}$ (no.) | Non – effective tillers $hill^{-1}$ (no.) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
|---|---|---|---|---|---|
| $M_1$ | 67.41f | 9.16d | 3.902 | 2.54c | 3.41d |
| $M_2$ | 72.65e | 9.60cd | 2.065 | 3.29bc | 4.12cd |
| $M_3$ | 76.67cd | 11.00abc | 3.267 | 3.75ab | 4.50bc |
| $M_4$ | 77.56abc | 11.20ab | 3.497 | 4.38ab | 4.33bc |
| $M_5$ | 77.03bcd | 10.38a-d | 4.118 | 4.04ab | 4.50bc |
| $M_6$ | 74.88de | 9.46d | 4.328 | 4.64a | 5.68a |
| $M_7$ | 79.66a | 9.93bcd | 3.610 | 4.12ab | 5.25ab |
| $M_8$ | 79.43ab | 11.71a | 3.508 | 4.45a | 5.66a |

| | | | | | |
|---|---|---|---|---|---|
| Level of significance | ** | ** | NS | ** | ** |
| $S_{\bar{X}}$ | 0.8017 | 0.4481 | 0.5215 | 0.3471 | 0.2941 |

Figures in a column having the similar letter (s) do not differ significantly whereas figures having dissimilar letter(s) significantly as per DMRT.

** Significant at $p \leq 0.01$ and NS = Not significant.

$M_1$ = Control (No poultry manure and NPKS fertilizers), $M_2$ = 100% NPKS (Recommended dose of Urea = 305 kg ha-1, TSP = 76 kg ha-1, MP = 60 kg ha-1, Gypsum = 30 kg $ha^{-1}$), $M_3$ = Poultry manure at 2.5 t $ha^{-1}$ + 50% NPKS, $M_4$ = Poultry manure at 5 t $ha^{-1}$ + 50% NPKS, $M_5$ = Poultry manure at 7.5 t $ha^{-1}$ + 50% NPKS, $M_6$ = Poultry manure at 2.5 t $ha^{-1}$ + 75% NPKS, $M_7$ = Poultry manure at 5 t $ha^{-1}$ + 75% NPKS and $M_8$ = Poultry manure at 7.5 t $ha^{-1}$ + 75% NPK

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